

Amendments to the Claims

1. (Twice Amended) A composition for coating or touching up or both coating and touching up a metal surface, said composition comprising water and:

(A) from about 0.5 millimoles per kilogram to about 240 millimoles per kilogram, a unit hereafter abbreviated as "mM/kg" of a component of fluorometallate anions, each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron, and, optionally, one or both of

(iii) at least one ionizable hydrogen atom; and

(iv) at least one oxygen atom;

(B) from about 0.5 grams/liter to about 10 grams/liter, a unit hereafter abbreviated as g/l, of a component of phosphorus-containing inorganic oxyanions or phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions calculated as the stoichiometric equivalent of [H.sub.3 PO.sub.4] H₃PO₄; [and]

(C) from about 0.5 g/l to about 3.5 g/l of hexavalent chromium[.];

(D) from about 0.10 g/l to about 2.20 g/l of trivalent chromium cations; and

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(E) a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants;

said liquid composition comprising not more than 0.06% of dispersed silica and silicates.

7. (Twice Amended) A composition for coating or touching up or both coating and touching up a metal surface, said composition being made by mixing together a first mass of water and at least the following components:

(A) a second mass of a water-soluble source of fluorometallate anions to provide in the composition from about 0.5 mM/kg to about 240 mM/kg of the fluorometallate anion, each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron; and, optionally, one or both of

(iii) at least one ionizable hydrogen atom, and

(iv) at least one oxygen atom;

(B) a third mass of one or more water-soluble sources of phosphorus-containing inorganic oxyanions, phosphonate anions or both phosphorus-containing inorganic

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oxyanions and phosphonate anions; to provide in the composition from about 0.5 g/l to about 10 g/l, calculated as their [stoichiometric] stoichiometric equivalent of [H.sub.3 PO.sub.4] H₃PO₄; [and]

(C) a fourth mass of a water-soluble source of hexavalent chromium cations to provide the composition with from about 0.5 g/l to about 3.5 g/l of hexavalent chromium cation;

(D) a fifth mass of a component to provide the composition with from about 0.10 g/l to about 2.20 g/l of chromium(III) cation; and

(E) a sixth mass of a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants.

17. (Twice Amended) A process for coating or touching up or both coating and touching up a surface, said surface comprising at least one area of bare metal, at least one area of coating over an underlying metal substrate, or both of at least one area of bare metal and at least one area of coating over an underlying metal substrate, said process comprising operations of:

(I) covering the areas to be coated, touched up, or both coated and touched up with a layer of a liquid composition, said liquid composition having been made by mixing together a first mass of water and at least the following components:

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(A) a second mass of a water-soluble source of fluorometallate anions to provide in the composition from about 0.5 mM/kg to about 30 mM/kg of the fluorometallate anion, each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron; and, optionally, one or both of

(iii) at least one ionizable hydrogen atom; and

(iv) at least one oxygen atom;

(B) a third mass of one or more water-soluble sources of phosphorus-containing inorganic oxyanions, phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions; to provide in the composition from about 0.5 g/l to about 10 g/l, calculated as their [stoichiometric] stoichiometric equivalent or [H.sub.3 PO.sub.4] H₃PO₄; [and]

(C) a fourth mass of a water-soluble source of hexavalent chromium cations to provide the composition with from about 0.5 g/l to about 3.5 g/l of hexavalent chromium cation;

(D) a fifth mass of component to provide the composition with from about 0.10 g/l to about 2.20 g/l of chromium(III) cation[,] ; and

(E) a sixth mass of a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms

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and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants.

23. (New) A composition for coating or touching up or both coating and touching up a metal surface, said composition comprising water and:

(A) from about 0.5 millimoles per kilogram to about 240 millimoles per kilogram, a unit hereafter abbreviated as "mM/kg" of a component of fluorometallate anions, each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron, and, optionally, one or both of

(iii) at least one ionizable hydrogen atom; and

(iv) at least one oxygen atom;

(B) from about 0.5 grams/liter to about 10 grams/liter, a unit hereafter abbreviated as g/l, of a component of phosphorus-containing inorganic oxyanions or phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions calculated as the stoichiometric equivalent of H_3PO_4 ;

(C) from about 0.3 g/l to about 30 g/l of hexavalent chromium;

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(D) from about 0.10 g/l to about 20 g/l of trivalent chromium cations; and

(E) a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants.

24. (New) The composition according to claim 23, wherein the total concentration of chromium atoms of any valence is from about 0.45 g/l to about 50 g/l.

25. (New) The composition according to claim 23, wherein the surfactant is selected from the group consisting of salts of carboxylic acids, alkylsulphonates, alkyl-substituted phenylsulphonates; alkyl-substituted diphenylacetylenic alcohols, nonylphenol polyoxyethylenes and alkylammonium salts.

26. (New) A composition for coating or touching up or both coating and touching up a metal surface, said composition being made by mixing together a first mass of water and at least the following components:

(A) a second mass of a water-soluble source of fluorometallate anions to provide in the composition from about 0.5 mM/kg to about 240 mM/kg of the fluorometallate anion.

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each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron; and, optionally, one or both of

(iii) at least one ionizable hydrogen atom, and

(iv) at least one oxygen atom;

(B) a third mass of one or more water-soluble sources of phosphorus-containing inorganic oxyanions, phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions; to provide in the composition from about 0.5 g/l to about 10 g/l, calculated as their stoichiometric equivalent of H_3PO_4 ;

(C) a fourth mass of a water-soluble source of hexavalent chromium cations to provide the composition with from 0.3 g/l to about 30 g/l of hexavalent chromium cations;

(D) a fifth mass of a component to provide the composition with from 0.10 g/l to about 20 g/l of chromium(III) cation; and

(E) a sixth mass of a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants.

27. (New) A process for coating or touching up or both coating and touching up a surface, said surface comprising at least one area of bare metal, at least one area of coating over an underlying metal substrate, or both of at least one area of bare metal and at least one area of coating over an underlying metal substrate, said process comprising operations of:

(I) covering the areas to be coated, touched up, or both coated and touched up with a layer of a liquid composition, said liquid composition having been made by mixing together a first mass of water and at least the following components:

(A) a second mass of a water-soluble source of fluorometallate anions to provide in the composition from about 0.5 mM/kg to about 30 mM/kg of the fluorometallate anion, each of said anions consisting of:

(i) at least four fluorine atoms; and

(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron; and, optionally, one or both of

(iii) at least one ionizable hydrogen atom; and

(iv) at least one oxygen atom;

(B) a third mass of one or more water-soluble sources of phosphorus-containing inorganic oxyanions, phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions; to provide in the composition from about 0.5 g/l to about 10 g/l, calculated as their stoichiometric equivalent or H_3PO_4 ;

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(C) a fourth mass of a water-soluble source of hexavalent chromium cations to provide the composition with from 0.3 g/l to about 30 g/l of hexavalent chromium cation;

(D) a fifth mass of component to provide the composition with from 0.10 g/l to about 20 g/l of chromium(III) cation; and

(E) a sixth mass of a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants;

said composition not comprising more than about 0.060% of dispersed silica and silicates; and

(II) drying in place over the surface the liquid layer formed in operation (I).

28. (New) A composition made by mixing together a first mass of water and at least the following components:

(A) a second mass of a water-soluble source of fluorometallate anions to provide in the composition from about 0.5 mM/kg to about 240 mM/kg of the fluorometallate anion, each of said anions consisting of:

(i) at least four fluorine atoms; and

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(ii) at least one atom of an element selected from the group consisting of titanium, zirconium, hafnium, silicon, aluminum, and boron; and, optionally, one or both of

(iii) at least one ionizable hydrogen atom, and

(iv) at least one oxygen atom;

(B) a third mass of one or more water-soluble sources of phosphorus-containing inorganic oxyanions, phosphonate anions or both phosphorus-containing inorganic oxyanions and phosphonate anions; to provide in the composition from about 0.5 g/l to about 10 g/l, calculated as their stoichiometric equivalent of H_3PO_4 ;

(C) a fourth mass of chromic acid in an amount sufficient to provide the composition with from 0.3 g/l to about 30 g/l of hexavalent chromium cations, and 0.10 g/l to about 20 g/l of chromium(III) cations through reduction of a portion of said chromic acid with a fifth mass of organic reducing agent;

(D) a fifth mass of organic reducing agent in an amount sufficient to produce said 0.10 g/l to about 20 g/l of chromium(III) cation by reaction with said portion of said chromic acid; and

(E) a sixth mass of a component of surfactant molecules that are not part of any of immediately previously recited components, said surfactant containing carbon atoms and fluorine atoms, said fluorine atoms bonded directly to carbon atoms in the molecules and being selected from the group consisting of anionic surfactants, nonionic surfactants, and cationic surfactants.

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29. (New) The composition according to claim 28, wherein the organic reducing agent is a carbohydrate.

30. (New) The composition according to claim 29, wherein the carbohydrate is a sugar or a starch.